CULL DEVELOPMENT

Under All-Aged Management of Hardwood Stands

by
GEORGE R. TRIMBLE, JR.

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The Author —

GEORGE R. TRIMBLE, JR., *a research forester, is leader of the Northeastern Forest Experiment Station's silviculture research project at Elkins, West Virginia. A graduate of the University of Maine Forestry School, he joined the staff of the Northeastern Station in 1939. He has worked in watershed-management research in both West Virginia and New Hampshire, and has worked on forest-management problems throughout most of the Northeastern States.*

The Question of Cull

MOST of our present stands of eastern hardwoods grew up — without benefit of silviculture — after the original timber was cut off some 50 to 100 years ago. Through the years since then, these stands have been subjected to varying degrees of damage and attrition from fire, grazing, insect and disease attack, and further cutting.

Many of these stands are uneven-aged. They are composed of leftovers from past cutting operations, plus some second growth, plus a scattering of trees of shade-tolerant species that have found their way into the overstory through openings created when older trees were cut or died from natural causes. In their wild state, these stands contain many defective trees — culls[1] —

[1]In the Northern Appalachian region, with which this report deals, culls are defined as follows: in the size class from 5 to 11 inches d.b.h., any tree that does not have a sound 12-foot section to a 4-inch top, inside bark; or, for stems too small to make 12 feet to a 4-inch top, any tree that does not have a potentially sound 12-foot section. In the size class larger than 11 inches d.b.h. (sawtimber trees), any tree that is not at least 50 percent sound to an 8-inch top, inside bark, or does not have a 16-foot log of sound merchantable material. Besides rot, sweep or extreme roughness can make a log unmerchantable and thus make the tree a cull.

which have no market value now or in the foreseeable future, and which occupy space that otherwise could be producing good stems (fig. 1).

Figure 1.—An old residual beech sawtimber cull. The workman is applying ammate crystals in notches to kill the tree.

Since the advent of the Civilian Conservation Corps in 1933, and especially since World War II, large areas of the eastern hardwood forests have been put under some degree of management. In most stands culls are a real problem. One of the first steps in a management program is to eliminate these worthless trees. Some stands are so cluttered with culls that complete removal of the overstory and regeneration of a new stand may be the best course of action. However, these are extreme cases:

usually the treatment can be less drastic, so that a manageable stand is left after cull removal.

But after the culls have been removed, and a management program has been begun, new cull trees will in time develop. The question is: how much of a job will it be to keep such stands free of culls?

A good indication of the size of this job is provided by records for a number of areas on the Fernow Experimental Forest near Parsons, West Virginia, where the development of cull has been studied in the course of experimental selection management practices used by the Northeastern Forest Experiment Station of the U. S. Forest Service.

The Study Area

The Fernow Forest was virgin timber until about 1905. Cuttings at that time varied between clear-cutting and high-grading for sawlogs. Controlled experimental cuttings were begun in 1949. At that time the Forest had been protected from fire, grazing, and cutting for about 30 years.

Before it was placed under management, the Fernow Forest had 10 to 20 percent of its total sawtimber stand volume in cull trees. Although this is a lot of cull, the percentage of the volume in cull trees probably was lower here than in most Appalachian woodlands.

There are 10 areas on the Fernow Forest for which cull development records are available for periods of 5 to 10 years (table 1). Six of these areas are under *intensive* selection management, a system in which all trees 5 inches d.b.h. and larger are considered in stand treatments, and in which all culls down to a 5-inch minimum diameter are killed. Four of the areas are under *extensive* selection management, in which stand treatments and cull removal are applied only to trees larger than 11 inches d.b.h. One-hundred-percent inventories, made on these areas before and periodically after the beginning of management, show the extent of cull-tree development under the two management programs.

Table 1.—Study areas examined for cull-tree development under selection management

Area	Acres	Site[1] index	First harvest cut under management	Cutting cycle	Original volume per acre			
					Merchantable		Cull	
					5-11 in.	11 in. +	5-11 in.	11 in. +
	No.	*Feet*	*Year*	*Years*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*
INTENSIVE SELECTION MANAGEMENT								
18A	29	80	1952	[2]5	1,097	11,941	9	512
18B	42	70	1952	5	643	14,567	11	2,812
18C	45	60	1952	([3])	572	10,106	33	3,801
8D	5	80	1949	5	508	12,545	14	1,208
Tier A	15	90	1954	10	853	13,810	6	1,108
Tier C	15	60	1956	10	794	6,164	37	950
EXTENSIVE SELECTION MANAGEMENT								
16A	24	80	1951	20	1,061	14,488	2	496
16B	34	70	1951	10	919	11,883	3	1,527
16C	19	70	1951	10	539	12,119	9	2,788
8C	5	80	1949	10	404	13,271	18	1,281

[1]Site index for oak from Schnur, G. L. YIELD, STAND, AND VOLUME TABLES FOR EVEN-AGED UPLAND OAK FORESTS. U. S. Dept. Agr. Tech. Bul. 560, 1937.

[2]Long-range plan sets cycle at 5 years, but second cut is not planned until 1964.

[3]Flexible: length of cycle determined by growth.

Results

Effect of Time after Logging and Treatment

The development of new cull trees after the initial elimination of culls at the time of the first management cut has been very slow (table 2). For all study areas, which include 233 acres all together, the average per-acre volume in sawlog-size cull trees after 5 years was only 46 board feet — a development rate of 9 board feet per acre per year. For the 92 acres for which we have 10-year records, the average per-acre volume in sawlog culls after 10 years was 108 board feet — a development rate of 11 board feet per acre per year.

Figure 2.—A 14-inch cucumber tree that has become a cull because of rot spreading from 10-year-old logging injuries.

Table 2.—Number and volume of cull trees per acre that developed after the original cull elimination under selection management

Area	Cull trees				Volume of cull trees			
	5-years after		10-years after		5-years after		10-years after	
	5-11 in.	11 in. +	5-11 in.	11 in. +	5-11 in.	11 in. +	5-11 in.	11 in. +
	No.	*No.*	*No.*	*No.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*
INTENSIVE SELECTION MANAGEMENT								
18A	1.7	[1]0.1	2.1	0.3	7	6	10	38
18B	1.9	[1] .1	—	—	8	28	—	—
18C	4.5	.4	—	—	20	65	—	—
8D	.0	.0	1.2	.0	0	0	8	0
Tier A	.5	.0	—	—	2	0	—	—
Tier C	2.7	.0	—	—	9	0	—	—
EXTENSIVE SELECTION MANAGEMENT								
16A	4.6	0.3	—	—	25	35	—	—
16B	5.1	.5	2.9	0.8	27	115	18	191
16C	7.0	.6	2.9	.8	34	85	20	121
8C	.6	.0	.6	.0	4	0	4	0

[1]Less than 0.1.

The data indicate — though certainly not conclusively — that cull-tree development in the larger size classes accelerates with time after logging. This is a logical trend insofar as cull is related to logging injuries. Rot develops and spreads from these injuries until it reaches a point where the tree is defined as a cull (fig. 2). In larger trees this deterioration is rather prolonged, and the time lags that are involved could reasonably be expected to result in accelerated cull development with the passing years.

The acceleration in cull development very likely continues longer than the 10-year period of our observations. We know that the volume in cull trees is only a partial measure of the defective material in a stand: many merchantable trees contain rotten or otherwise unusable segments. Much of this defect is a result of logging injuries. The volume of this defective material

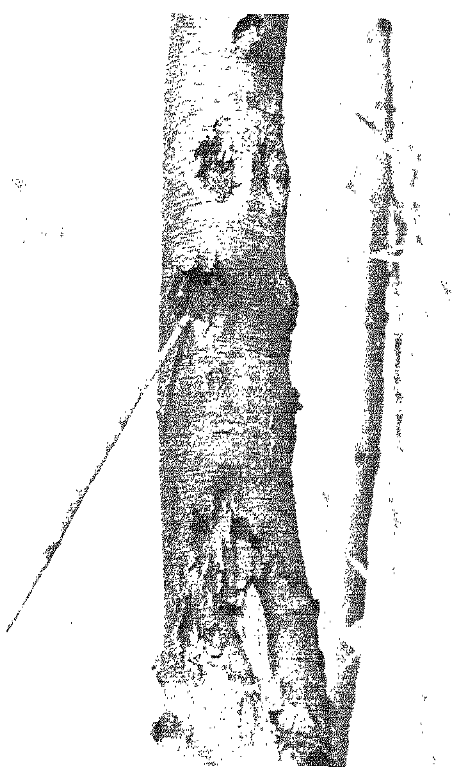

Figure 3.—A sweet birch that has become a cull because of cankers.

in merchantable trees probably is greater 5 to 10 years after logging than the volume in trees that have gone completely over into the cull category. And unless harvested soon, many of these damaged merchantable trees can become culls — given a little more time.

On the six intensive selection areas where small as well as large culls were eliminated originally, cull development among stems below sawtimber size was remarkably slow. For all 151 acres in these areas, the average per-acre volume in cull trees of this size class was 11 cubic feet after 5 years. On the 2 areas totaling 30 acres where 10-year observations were made, the average per-acre volume in cull trees went from 6 cubic feet at 5 years to 10 cubic feet at 10 years. This is cull-tree development at a rate of only about 1 cubic foot per acre per year for the 10-year period.

On the four extensive selection areas, where small culls were not killed originally, average cull-tree volume in the small diameter range went from 5 cubic feet before cutting to 27 cubic feet 5 years later. At the end of the second 5-year period, the average had dropped to 17 cubic feet.

The records for the extensive selection areas indicate that shortly after logging a number of 5- to 11-inch culls developed. Then their numbers declined. What happened to these culls between the 5- and 10-year measurements? Did they grow into the sawlog class, or did they die out? Casual observation leads us to speculate that many of the 5- to 11-inch culls died out, at least among those in the lower part of this size range. These defective understory trees were of lower than average vigor. Weakened as they were by injury and, in many instances, also by disease, most of them apparently did not last long. On the other hand, a substantial proportion of the larger culls in this size class (9- and 11-inch) probably moved up as culls into the sawlog class.

Observations on a number of small culls leads us to believe that logging damage was a major cause of the defects that degraded them to cull status. However, in the case of sweet birch, we found that many trees became culls as a result of Nectria canker attacks (fig. 3).

Relationships between Cull Development and Size of Culls Killed Originally

Under extensive selection management, only the cull trees of sawlog size (larger than 11 inches d.b.h.) were killed; whereas under intensive selection management all culls over 5 inches d.b.h. were killed. So, at equal periods of time after initial treatment, we could reasonably expect greater cull volumes under extensive management in both the sawlog and under-sawlog size classes. The greater volume in the sawlog class would come from ingrowth by culls that were less than 11 inches d.b.h. when the stand was treated.

The data, summarized in table 2, support these expectations. Since 10-year observations were obtained on only two areas under intensive management, the best evidence came from the 5-year measurements. Five years after cutting and cull treatment under intensive management, cull volume was 11 cubic feet in 5- to 11-inch trees, and 28 board feet in the sawlog portion of the stand. Under extensive management, comparable figures were 27 cubic feet and 78 board feet.

Effect of Species

In mixed stands, such as those on the Fernow Forest, culls may reasonably be expected to develop more commonly in some species than in others, either because of greater susceptibility to disease (rots and cankers) or because of greater susceptibility to logging damage. One measure of this expected tendency is to compare the relative frequency of different species in the merchantable stand with their relative frequency among the culls. This was done.

The species that consistently appeared in higher proportions among the culls were: sweet birch, sassafras, Fraser magnolia, cucumber tree, basswood, and red maple. For example, in one compartment, sweet birch and basswood were the two species most numerous among the culls; yet they were fourth and fifth in numerical order of abundance in the merchantable stand. On another area, sassafras was the most numerous among the culls but ranked fifth in the merchantable stand. In contrast, the oaks were in relatively smaller proportions among the culls.[2]

One obvious reason for the large proportions of sweet birch and sassafras among the culls was the high incidence of canker on these species.

Summary and Conclusion

Cull-tree development was observed at intervals of 5 and 10 years after selection management was begun in hardwood stands in West Virginia. The first steps in management were a logging operation based on selection marking, followed by treatment to eliminate cull trees. On some areas all culls 5 inches d.b.h. and larger were treated; on others only the 11-inch and larger culls were treated. The rate at which new culls developed was related to time after logging and cull treatment, size range of culls treated, and species.

The development of new culls during the 5- and 10-year intervals after the initial elimination of culls was remarkably slow. Logging damage to residual trees appeared to be the principal reason for development of the new culls that did appear, particularly in the sawlog portion of the stands. If the old culls had been killed without an accompanying logging operation, the subsequent development of new culls no doubt would have been even slower.

For eastern hardwood stands similar to those on the Fernow Experimental Forest, the conclusion reached from this study is that cull-tree elimination need be no more than a minor and periodic operation after one thorough initial treatment has been made.

[2]A study of log defects in the southern Appalachians revealed a similar relationship among species; that is, oak logs were found to have less defect than logs of most other species. *See* Jiles, Robert A. SCALABLE DEFECTS IN HARDWOOD LOGS. Tennessee Valley Authority Div. Forestry Relat. Tech. Note 25, 1956.